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PEST MANAGEMENT PRACTICES OF FARMERS AND IMPACT OF PESTICIDES ON MAIZE, WATER AND COMMUNITY IN ADAMAWA, NIGERIA

MOHAMMED AHMED

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By

MOHAMMED AHMED

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

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DEDICATION

This thesis is dedicated to my Late father Mal. Ahmadu Hayatu Karlahi and to the memories of my Late Mother Malama. Amina Ahmadu Karlahi, my sister Late Maimuna Ahmadu Karlahi, may their souls rest in peace AMEEN…and my brothers Ibrahim Ahmadu Hayatu Karlahi and Abubakar (Danjuma) Ahmadu Hayatu Karlahi. This work is also dedicated to my amiable supervisor Dr. Norida Mazlan and the entire staff of faculty of Agriculture Universiti Putra Malaysia. I also dedicated the thesis to my Dean Alh. Soba and my H.O.D Sani Saidu Gaya of Agricultural Education Department, Federal College of Education, Yola.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in Fulfilment of the requirement for the degree of Doctor of Philosophy

PEST MANAGEMENT PRACTICES OF MAIZE CROP AND PESTICIDE USED IMPACT ON CROPS, WATER AND COMMUNITY IN ADAMAWA, NIGERIA

By

MOHAMMED AHMED

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Chairman : Associate Professor Norida Mazlan, PhD
Faculty : Agriculture

Maize is an essential cereal crops that is widely cultivated in Adamawa state, Nigeria. It is cultivated and consumed as a staple food. Pesticide is one the most common pest management method used by maize farmers to reduce the impacts from pest which contributed to yield declined. Many researches had been conducted on impact of pesticide residues on different types of vegetables and tree crops but little or no study have been conducted on impact of pesticide residues on maize and water and its risks on human. In order to bridge these gaps, the objective of this study focused on pest management practices of maize, the residue of pesticides used in maize and water, and its risk on the community in Adamawa state, Nigeria. Structured questionnaire was constured and distributed to respondents. Random sampling technique was employed to select the respondents in the four study areas which are Chigari, Dasin Hausa, Gurin and Lake Gerio, with 80 farmers in each areas, hence the total number of respondents for the study was 320. During the survey, questions on the total amount of maize and water consumed and mean weight of farmers were included. The data from survey were analysed with pearson correllation, descriptive and factor analysis using SPSS software. The pesticide and the residues of commonly used by farmer in the study areas were extracted and analysed from maize and water using QuEChERS and DLLME method respectively. The risk on community were counted following the determination of Estimated Daily Intake (EDI) of water and maize from the area. The pest management survey's result shows pesticide is the main pest management practices by the farmers. Three types of pesticide commonly used are organochlorine, organophosphate and pyrethroids. There were 19 residues of organochlorines, organophosphates and pyrethroids were found higher in water than the maize samples from the study areas. The residue analysis in maize and water indicated that organochlorine pesticide residues in water were mostly above European Maximum Residue Level (EU MRL)

with few of organophosphates and pyrethroid, but lower in maize samples across the study areas. The findings from pesticide residue risk assessment shown that water samples contained the most contaminants from all the areas which are cypermethrin, permethrin, bifenthrin, malathion and diazinon. In regard to areasthe results indicated that Lake-Gerio has the highest risk cases of prevalent pesticide residues contaminants and Dasin-Hausa has the lowest risk cases among the four areas under study. Most farmers in the study areas lack adequate knowledge of correct principles of pest management practices due to poor educational background that led to neglecting necessary precautionary measures. This might be due to lack of extension services to rural farmers on part of the government. There is need to create awareness among farmers on Integrated Pest Management (IPM) system and Good Agricultural Practices (GAP) that is environmentally friendly.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

AMALAN PENGURUSAN PEROSAK TANAMAN JAGUNG DAN KESAN PENGGUNAAN RACUN MAKHLUK PEROSAK TERHADAP TANAMAN, AIR DAN KOMUNITI DI ADAMAWA, NIGERIA

Oleh

MOHAMMED AHMED

Februari 2019

Pengerusi : Profesor Madya Norida Mazlan, PhD
Fakulti : Pertanian

Jagung adalah tanaman bijirin penting yang ditanam secara meluas di negeri Adamawa, Nigeria. Ia ditanam dan dimakan sebagai makanan ruji. Racun perosak adalah salah satu kaedah pengurusan perosak yang paling biasa digunakan oleh petani jagung untuk mengurangkan kesan daripada perosak yang menyumbang kepada penurunan hasil. Banyak kajian telah dijalankan tentang kesan sisa-sisa racun makhluk perosak terhadap pelbagai jenis sayur-sayuran dan tanaman pokok tetapi sedikit atau tiada kajian telah dilakukan terhadap kesan sisa-sisa racun makhluk perosak terhadap jagung dan air serta risiko-risikonya terhadap manusia. Untuk merapatkan jurang ini, matlamat kajian ini adalah untuk memberi tumpuan kepada amalan pengurusan makhluk perosak jagung, sisa racun perosak yang digunakan dalam jagung dan air, dan risiko kepada masyarakat di negeri Adamawa, Nigeria. Soal selidik berstruktur telah dirangka dan diedarkan kepada responden. Teknik pensampelan secara rawak digunakan untuk memilih responden di empat kawasan kajian iaitu Chigari, Dasin Hausa, Gurin dan Lake Gerio, dengan 80 petani di setiap kawasan, dengan jumlah responden untuk kajian ini adalah 320. Semasa tinjauan dilakukan, soalan mengenai jumlah jagung dan air yang diambil dan berat badan petani dimasukkan. Data dari kaji selidik dianalisis dengan korelasi pearson, analisis deskriptif dan faktor menggunakan perisian SPSS. Racun perosak dan sisa-sisa yang biasa digunakan oleh petani di kawasan kajian telah diekstrak dan dianalisis dari jagung dan air masing-masing menggunakan kaedah QuEChERS dan DLLME. Risiko kepada komuniti dikira menggunakan penentuan Anggaran Pengambilan Harian (APH) air dan jagung dari kawasan tersebut. Hasil soal selidik pengurusan perosak menunjukkan racun perosak adalah amalan pengurusan perosak utama oleh para petani. Tiga jenis racun perosak yang biasa digunakan adalah organoklorin, organofosfat dan pyrethroid. Terdapat 19 sisa organoklorin, organofosfat dan pyrethroid yang didapati lebih tinggi di dalam air daripada sampel

jagung dari kawasan kajian. Analisis sisa dalam jagung dan air menunjukkan bahawa sisa racun perosak organoklorin dalam kebanyakan air berada di atas Tahap Sisa Maksimum Eropah (TSM EU) dengan beberapa organofosfat dan pyrethroid, tetapi lebih rendah di dalam sampel jagung di seluruh kawasan kajian. Penemuan dari penilaian risiko sisa racun perosak menunjukkan bahawa sampel air mengandungi bahan pencemar yang terbanyak dari semua kawasan iaitu cypermethrin, permethrin, bifenthrin, malathion dan diazinon. Berkenaan dengan kawasan, keputusan menunjukkan bahawa Lake-Gerio mempunyai kes-kes risiko tertinggi bagi pencemaran sisa racun makhluk perosak dan Dasin-Hausa mempunyai kes-kes risiko terendah di antara empat kawasan yang dikaji. Kebanyakan petani di kawasan kajian tidak mempunyai pengetahuan yang memadai tentang prinsip-prinsip pengurusan perosak yang betul disebabkan oleh latar belakang pendidikan yang kurang baik yang menyebabkan mereka mengabaikan langkah berjaga-jaga yang penting. Ini mungkin disebabkan oleh kurangnya perkhidmatan pengembangan kepada petani luar bandar oleh kerajaan. Terdapat keperluan untuk mewujudkan kesedaran di kalangan petani mengenai sistem Pengurusan Perosak Bersepadu (PPB) dan Amalan Pertanian Baik (APB) yang mesra alam.

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This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

Norida Mazlan, PhD
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Chairman)

Dzolkhifli Omar, PhD
Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

Norsida Man, PhD
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

ROBIAH BINTI YUNUS, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

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Signature: _____

Name of Chairman of Supervisory Committee: Associate Professor Dr. Norida Mazlan

Signature: _____

Name of Member of Supervisory Committee: Professor Dr. Dzolkhifli Omar

Signature: _____

Name of Member of Supervisory Committee: Associate Professor Dr. Norsida Man

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LIST OF ABBREVIATIONS

ADI	Average Daily Intake
ADP	Agricultural Development Project
AUN	American University of Nigeria
BP	Blood Pressure
CABI	Commonwealth Agricultural Bureau International
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyl trichloroethane
DLLME	Disperse Liquid-Liquid Extraction Method
d-SPE	Disperse solid phase extraction
DV	Dependent Variable
EADI	Estimated Average Daily Intake
EPA	Environmental Protection Agency
EU	European Union
"EU"	Experimental Unit
ERL	Effect Low Range
FADAMA	United Nation collaborate with Federal Govt. program.
FAO	Food and Agriculture Organization
GC-MS	Gas Chromatography-Mass Spectrometry
HCB	Hexachloro Benzene
HCH	Hexachloro cyclohexane
HQ	Hazard Quotient
IPM	Integrated Pest Management
IITA	International Institute for Tropical Agriculture
IRRI	International Rice Research Institute
IV	Independent Variable

LOD	Level of Detection
LOQ	Level of Quantification
MEC	Measured Environmental Concentration
MRL	Maximum Residual Level
NAFDAC	National Agency for Food and Drugs Administration and Control
NBS	National Bureau of Statistics
NCDs	Non Communicable Diseases
NGOs	Non-Governmental Organization
PPb	Parts per billion
PPE	Personnel Protective Equipment
PHI	Pre-Harvest Interval
PNEC	Probable No-Effect Concentration
POP	Persistent Organic Pollutant
PSA	Primary Secondary Amines
QuEChERS	Quick Easy Cheap Effective Rugged Safe
R & D	Research and Development
RQ	Risk Quotient
SPSS	Statistical Package for Social Sciences
UN	United Nation
WARDA	West African Rice Development Association
WAAP	West African Agricultural Productivity Program

CHAPTER 1

INTRODUCTION

Maize is among the most essential cereal crop that is widely cultivated globally. In Nigeria, it is cultivated and consumed as a staple food and is regarded as the second most cultivated crop after rice. In 2013, more than 5.56 million hectares (ha) of land in Nigeria has been cultivated for maize production, (Tsedeke et al; 2014). To fulfill the country's food demand due to increasing population. In order to reduce the impacts of damages and disease which could decline the yield and price of the commodity of maize, cultural and chemical control measures in pest management practices on maize by farmers commonly being practiced in Nigeria. However, effective pest management practices are more inclined to usage of chemical pesticides. Despite high yield obtained from using pesticides in agricultural production, human and animals health with environmental consequences are in great danger (Aderonke et al., 2013; Joseph et al., 2014; Obidah et al., 2012).

1.1 Background of the study

There is no doubt that new agricultural technology and attractive prices in both local and modern markets generate huge farm investments and income streams that simultaneously tend to increases agricultural productivity in order to meet-up with the increasing demand of the increasing population of the world. The farmers through intensive cultivation of crops using pesticides for pest and weeds control to reduce damages and to obtain high yield, even though it has toxicological effects which could be acute or chronic. Report indicated that global application of pesticide have been in increase significantly during the last three decades.

Asogwa & Dongo (2009) reported about 125,000-130,000 metric tons of pesticides were applied annually in Nigeria. Ikemefuna (1998) in Asogwa & Dongo (2009) asserted that, pesticide usage in Nigeria has been on the increase ever since its introduction. Nigerian agriculture is still dependent on pesticides and synthetic fertilizers so as to attain acceptable level of food security. Many studies in relation to impacts of pesticide residues on vegetables, consumers and other tree crops are found Shehu et al., 2007; Ahaneku et al., 2013; Aderonke et al., 2013). However, but little or no study on impacts of pesticide residues on cereal crops especially maize which is the main staple food crop grown in Adamawa state.

The state ecological zone has tremendous potentials for the maize crops production. The rise in maize production in the State is as a result of many small scale farmers searching for land to cultivate due to the socio-economic factors. Despite these factors, numerous challenges are identified by the researcher as major constraints in agricultural productivity; these include collapse in formal extension services to the

local farmers that occupied 80% of the populace in the state due to lack of proper funding by the Government. Many studies of pesticide residue and its impacts have been conducted in various fields especially on vegetables(Mazlan et al., 2005; Bernes-Perez et al., 2006; Grzywacz et al., 2010) and other tree crops (Katja et al., 2014), but little or no pesticide residues studies on cereal crops in North Eastern states of Nigeria particularly in Adamawa state.

1.2 Problem Statement

Over reliance on pesticides to obtain high yield and to attain food security causes pesticide residue contaminates to the ecosystem, and also inflict both acute and chronic diseases to both human and animals. Repeated application leads to loss of biodiversity, contaminate the groundwater and surface water, and enter the organism, bioaccumulate in food chains and consequently influence human health. Many researches have been conducted under the impact of pesticide residues on different types of vegetables and other tree crops, but little study have been conducted on impact of pesticide residues on maize crop and water and its related health risk in Adamawa state. It is at this juncture that the researcher intends to investigate pest management practices of farmers and impact of pesticides on maize, water and community in Adamawa, Nigeria.

1.3 Research Questions

a) What are the farmers pesticide management practices in Adamawa state and which types of most common pesticide used in the area?
b) What is the association between farmers' pest management practices with the quality of water and maize in the study areas?
c) What are the associations between pesticide residue concentrations and potential risk involved in farmers consuming maize and water samples from the study areas?

1.4 Hypotheses

Hyphothesis 1:

Hu1: There is no significant association between pesticide (insecitide and fungicide) applications and the severity level of pests in the study areas
Ha1: There is a significant association between insecticides applications and the severity level of pests in the study areas.

Hyphothesis 2:

Hu1: There is no significant association between herbicide applications and the severity level of weeds in the study areas

Ha1: There is a significant association between herbicides applications and the severity level of weeds in the study areas.

Hyphothesis 3:

Hypothesis null: There is no significant association between pesticide frequency applications and maize out put in the study areas

Hypothesis A: There is a significant association between pesticide frequency applications and maize out put in the study areas

1.5 The objectives of this study

Objective 1: To determine the pest management practices of maize farmers in Adamawa States.

Sub-objectives:

1a: To identify the major pest and the pest management practices of the maize farmers.

1b: To determine the association between frequently application and maize output.

1c: To identify factors that motivates farmers in Adamawa state to apply pesticide management practices.

Objective 2: To investigate the relationship on pest management with pesticide residue on maize and water from the study area.

Sub-objectives:

2a: To determine pesticide residue in maize from study area.

2b: To determine pesticide residue in water from study area.

Objective 3: To investigate the health risk of farming community in Adamawa from consuming the maize and water from study area.

1.6 Scope of the study

The study was conducted in Adamawa state which is located in North Eastern Nigeria on Latitude 7° and 11°N and Longitude 11° and 14°E. The state area is 38,823.31 km^2, it is mountainous topographically and crossed by rivers and valleys. The area of study which comprises Chigari, Dasin-Hausa, Gurin and Lake-Gerio covers about 6017.85 km^2 with population of 209,460 people. The area of study was selected on the bases that most of the population of the areas were maize farmers and taken farming as profession. Each area was divided into four experimental units, about 80 farmers was selected randomly from each area whose major occupation was predominantly farming. In total, 320 randomly selected farmers was sampled (that is 80 farmers × 4 Areas of study = 320 farmers). Similar sampling methods have been used by Ajayi (2005) in Nigeria, Njoroge (2002) in Kenya and Mekonen et al. (2015).

The samples collected for this study includes maize and water from nearby water source. The farmers were questions on their background and pest management practice. The pesticide residue levels in the samples from the areas were analysed with GC-MS and to assess the pesticide risk on community, the residue level were compared with European Maximum Residual Level (EU-MRL).

1.7 Significance of the study

The findings of this study can be of benefit to field researchers, farmers, extension service workers and legislatures to understand the impact of pesticide used in the current crop production which can be a reference point for the relevant parties to take necessary actions in reducing the impacts of the pesticide used in the state. The findings of this study can also be of important to all three-tiers of Government (Local, State and Federal government) as a guide in policy formulation and implementation regarding importation and utilization of required inputs for agricultural prosperity that can lead to safer agricultural practices and environmentally friendly by the farmers and consumers alike.

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BIODATA OF STUDENT

Mohammed Ahmed obtained Nigeria Certificate in Education from Federal College of Education, Yola in 1991, B. Tech. Ed (Hons) Agricultural Technology and M. Tech Agric Tech. degrees from Federal University of Technology, Yola and now Modibbo Adama University of Technology, Yola Adamawa State, Nigeria in 2001 and 2011 respectively. PhD in Agrotechnology from University Putra Malaysia (UPM) in the year 2019. Interested in pesticide residue analysis and health risk assessment in biodiversity.

LIST OF PUBLICATIONS

Norida Mazlan1*; Mohammed Ahmed1; Farrah Melissa Muharam1; Md. Amirul Alam2 (2017). Status of persistent organic pesticide residues in water and food and their effects on environment and farmers: a comprehensive review in Nigeria. *Semina: Ciências Agrárias, Londrina, v. 38, n. 4, p. 2221-2236,*

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